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Successful Recovery and Transplantation of Eleven Organs including Face, Bilateral Upper Extremities and Thoracic and Abdominal Organs from a Single Deceased Organ Donor

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Abstract

We report on the to date largest recovery of eleven organs from a single deceased donor with the transplantation of face, bilateral upper extremities, heart, 1 lung, liver (split for 2 recipients), kidneys, pancreas and intestine. Although logistically challenging, this case demonstrates the feasibility and safety of the recovery of multiple thoracic and abdominal organs with multiple vascular composite allotransplants (VCA) and tissues. Our experience of 8 additional successful multiple VCA, thoracic, and abdominal organ recoveries suggests that such procedures are readily accomplishable from the same deceased donor.

Introduction

Since 2009, the New England Organ Bank (NEOB) has collaborated in efforts to recover and transplant vascular composite allotransplants (VCAs), thoracic and abdominal organs from 9 deceased donors (**Table 1**). This report summarizes the largest procurement to date from a single donor with the procurement of 11 organs including face, bilateral upper extremities, heart, 1 lung, liver (split for 2 recipients), kidneys, pancreas and intestine.

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The authors of this manuscript declare no conflicts of interest.

Case Report

The donor was a 23 year-old Caucasian male who presented with a ruptured aneurysm of the middle cerebral artery. Upon admission to the hospital, he underwent a hemi craniotomy. He was pronounced dead by neurologic criteria 2 days later. The patient was registered as an organ and tissue donor. NEOB staff met with the patient's family to review the donor registration, discuss the donation process, and conduct a Donor Risk Assessment Interview. No social behavior of increased risk was reported by the next of kin. Standard serology assessment for viral infection, including nucleic acid testing, was nonreactive except for EBV-IgG.

The patient was a suitable donor for all thoracic and abdominal organs with the exception of the right lung-right upper lobe bronchi ruled the right lung out for transplantation. While evaluation of the thoracic and abdominal organs was in process, the NEOB staff reviewed the list of local VCA candidates to determine if the donor was a potential match for either face or upper extremity transplant based on ABO, age, skin tone, gender and HLA typing. The Brigham and Women's Hospital (BWH) VCA program tentatively accepted the face and bilateral upper extremities for 2 separate recipients. Specific family authorization was then obtained for recovery of the face and upper extremities. Additional testing, including photographic imaging of the face and arms, x-ray imaging of both upper extremities and ultrasound vein mapping were initiated.

A conference call was organized by the NEOB with representatives of all transplant centers involved in the recovery concluding with a plan to move forward with the procurement of face and bilateral upper extremities, heart, left lung, the liver (with the intention of a split for 2 recipients), pancreas, small intestine and both kidneys. The plan of the entire procedure was reviewed by the VCA team with an estimated 5-hour recovery time for the face and bilateral extremities to precede the thoracic and abdominal organ recovery. The abdominal transplant teams reviewed the assignment for the recovery of additional cervical and abdominal blood vessels for the liver, pancreas and intestinal allografts. There was a request by the intestinal team not to administer blood replacement during the recovery procedure unless irradiated to preclude exposure (and allograft transmission) of HLA antigens different from that of the donor HLA type (**Table 2**).

Given the lengthy recovery time, and in accordance with NEOB policy, the VCA transplant center agreed to have a stand-by abdominal transplant surgeon from their institution on site until the arrival of the liver recovery team. The abdominal transplant surgeon was not involved in the acceptance or recovery of any of the abdominal organs.

Organ procurement began first with the acquisition of the face and bilateral upper extremities as agreed. To facilitate facial allograft recovery, the endotracheal tube was disconnected briefly and ventilation was restored immediately thereafter with an endotracheal tube anchored by sutures to the soft palate and posterior pharynx. Following successful completion of the VCA procurement, the thorax and abdomen were then prepped and draped for organ recovery. There was a separate recovery team for the heart, lung, liver, pancreas, intestine, and kidneys. The donor vessels were distributed as follows: the common

iliac artery with its external and hypogastric artery segments were furnished with the right lobe of the liver; the intrathoracic carotid artery emanating from the innominate artery was furnished with the left lobe of the liver; the other common iliac artery with its bifurcated segments was furnished with the pancreas; the superior mesenteric artery was retained for the intestine; and the iliac, jugular and subclavian veins were dispersed as well. Three units of irradiated packed red blood cells were required during the procedure. All VCA, thoracic and abdominal organs were successfully transplanted. Following completion of the organ recovery, musculoskeletal tissue and saphenous veins from the lower extremities were also recovered for transplantation.

Discussion

26 face and 48 upper extremity transplants (25 bilateral and 23 single transplants) have been reported to the International Registry on Hand and Composite Tissue Allotransplantation by November 2014 (1). Vascular Composite allotransplants (VCAs) were added to the definition of “organs” in the Organ Procurement & Transplantation Network (OPTN) Final Rule in July, 2013 (2). As a result, oversight of donation and transplantation of face, extremities, abdominal wall and other VCAs has come under the regulatory purview of the OPTN/United Network for Organ Sharing (UNOS). A UNOS designated VCA Committee has emphasized the need for careful planning of the donation process, with collaboration between the Organ Procurement Organization (OPO), the VCA transplant team, and the other organ transplant teams.

We specify that separate and specific VCA authorization from the patient’s next-of-kin is required irrespective of the potential donor being registered. This is because we believe that people who register at the time of driver’s license renewal or online do not contemplate that they might be also be authorizing VCA donation. However, family authorization has been influenced by donor registration. Since initiating VCA recoveries in 2009, 28 potential donors have been identified based on the NEOB protocol; 14 (50%) families have authorized VCA donation and 9 patients ultimately became donors with a higher likelihood of VCA authorization if the donor was registered (60%) than not registered (25%) (Unpublished data, New England Organ Bank, Waltham, MA). Both New England Organ Bank and Brigham and Women’s Hospital have extensive experience with simultaneous VCA and solid organ procurements supporting the extensive organizational preparation of these cases.

There are other unique aspects about family authorization for VCA. The family discussion includes a description of the injury the intended candidate(s) has sustained and the impact the VCA will have on the life of the recipient. OPO staff explains to the family that prosthetics will replace the recovered face and/or extremities. Although every effort is made to ensure the anonymity of the donor, given the anticipated media attention, the family is advised that the donor’s identity may become publicly known.

Simultaneous VCA and other multiple organ recoveries require a carefully planned surgical approach. The distribution of multiple accessory vessels must be resolved in advance of the procedure. Moreover, with the extended procurement time currently required for the facial allograft recovery, an abdominal transplant surgeon should be present during the period of

VCA recovery to perform an emergency hepatectomy and nephrectomy, if the donor becomes hemodynamically unstable.

In the case reported here, the allocation of vessels was discussed during a preoperative conference call. The face team required a carotid artery and jugular vein for transplantation but agreed to leave at least 1 side with the majority of the common carotid and common jugular intact. Despite extensive planning, the right lobe liver team was unsatisfied with the extra vessels that were provided. To facilitate the transplantation of the right hepatic lobe, additional vessels were made available immediately and shared between centers. Eventually, arterial reconstructions were performed without the need for additional vessels. However, this event emphasizes the importance of continued discussion among transplant centers regarding recipient-specific needs during organ procurement.

Simultaneous VCA and solid organ procurements have been reported before, although not to the extent of our case (3, 4). All those cases include a careful organization and communication with all participating procuring surgeons. An algorithm for the simultaneous procurement of VCA and solid organs has been communicated before. With several alternatives of this algorithm, we have, as in previous less extensive combined VCA/SOT procurements, assured safety through a very careful surgical procurement technique and the presence of an experienced recovery surgeon in case of hemodynamic instabilities.

Conclusion

Multiple organ and VCA transplants can be safely and successfully accomplished with appropriate planning and coordination of all procuring teams and OPO representatives involved.

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Abbreviations

NEOB	New England Organ Bank
OPO	Organ Procurement Organization
OPTN	Organ Procurement & Transplantation Network
UNOS	United Network for Organ Sharing
VCA	Vascular Composite Allotransplant

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Table 1

A broad experience prior to this to date largest procurement of VCA and SOT had been in place within the NEOB.

YEAR	Age/Gender	VCA(s) Transplanted	Organs(s) Transplanted
2009	59/M	Partial face	Heart
2011	48/M	Full face	Liver, both kidneys
2011	31/M	Full face	Liver, both kidneys
2011	42/F	Full face, bilateral upper extremities	Liver, 1 kidney
2011	44/M	Bilateral upper extremities	Liver, both kidneys, 1 lung
2012	18/M	1 hand	Liver, both kidneys, both lung, pancreas
2013	56/F	Face & anterior neck	Liver, both kidneys
2014	51/M	Partial face	Liver, both kidneys
2014	23/M	Central face, bilateral upper extremities	Liver (split), both kidneys, heart, 1 lung, pancreas, intestine

Source: New England Organ Bank

Table 2

Detailed time schedule of organizational and communication efforts

Date	Time	Event
10/12/14	07:11	Patient referred to New England Organ Bank
10/12/14	11:00	NEOB staff on site to begin evaluation
10/12/14	13:24	Patient declared brain dead by neurologic criteria
10/12/14	16:09	Patient was a registered donor. Disclosure and Donor Risk Assessment Interview completed with the family
10/12/14	16:14	Serologies and Tissue Typing sent
10/12/14	17:26	Patient identified as a potential multiple VCA donor for 2 patients listed at Brigham and Women's Hospital (BWH)
10/12/14	19:03	BWH interested for both candidates. Blood sent for cross-matching
10/13/14	00:42	Serologies resulted
10/13/14	00:45	Thoracic allocation started
10/13/14	04:48	Liver and Intestine allocation started
10/13/14	08:26	Cross-match results negative for VCA candidates and reported to BWH
10/13/14	09:18	Kidney and Pancreas allocation started
10/13/14	10:21	Authorization obtained from family for VCA to include face and bilateral upper extremities
10/13/14	12:00	VCA candidates called in for transplant. Surgeons requested 22:00 OR time if other programs agreed.
10/13/14	17:16	Left lateral segment of liver accepted. Allocated right lobe and accepted at different center
10/13/14	18:30	Conference call held with all recovering surgeons to discuss: <ul style="list-style-type: none"> • Timeline of recovery – VCA's would need 5 hours • Abdominal surgeon needed during VCA recovery • Allocation of Vessels • Utilization of blood products
10/13/14	21:00	NEOB staff to OR to educate staff on process of multiple organ and VCA recovery
10/13/14	22:00	Patient entered OR
10/13/14	22:49	Tourniquet applied to RUE at 2249
10/13/14	22:49	Tourniquet applied to LUE at 2249
10/13/14	22:52	Incision for face
10/14/14	02:28	RUE recovered
10/14/14	02:32	LUE recovered
10/14/14	04:00	Face recovered
10/14/14	05:00	Incision for organs
10/14/14	10:13	Cross-clamp
10/14/14	10:28	Heart recovered
10/14/14	10:40	Intestine recovered
10/14/14	10:45	Left lung recovered

Date	Time	Event
10/14/14	10:58	Liver recovered
10/14/14	11:30	Pancreas recovered
10/14/15	11:33	Kidneys recovered
10/14/14	12:13	Exit OR
		TOTAL Operating Room Time – 14 hours 13 minutes TOTAL TIME from Referral to exiting OR 53 hours 2 minutes
		TOTAL Staff Involved: Hospital ICU Staff – 11 Hospital Operating Room – 7 Recovery Team Staff – 15 NEOB Staff – 11